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PROGRESS REPORT

DEVELOPMENT OF IMPROVED BLOWOUT PREVENTION PROCEDURES TO BE USED IN DEEP WATER DRILLING OPERATIONS

submitted to
The United States Geological Survey
Department of the Interior
Reston, Virginia



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PROGRESS REPORT

April 23, 1978 - July 23, 1979

Development of Improved Blowout Prevention
Procedures for Deep Water Drilling Operations

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Effective Date: August 23, 1978
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RESEARCH OBJECTIVES

A number of new blowout control problems are associated with moving into deep water drilling operations with floating drilling vessels. These problems become much more severe as the water depth increases, because of the increased length of the marine riser and subsea flowlines and the increased susceptibility of shallow formations to fracture. The primary objectives of the proposed research are the development of improved well control procedures to be used in deep water, floating drilling operations.

The overall research project being undertaken is the development of improved shut-in procedures, pump start-up procedures, and procedures for more safely circulating formation gas to the surface. In addition, an improved mathematical model of the well control process is being developed which will allow an accurate prediction of well behavior for various assumed operating procedures. An existing \$750,000.00 blowout control training well facility is being modified to accomplish these objectives.

The overall research plan was divided into eight tasks which would take approximately four years for completion. The project funding received under the present contract was \$187,096 to perform Tasks 1, 3, 4a-b, and 5. These tasks include:

| <u>Task</u> | <u>Description</u> |
|-------------|--|
| 1 | Design of a well for accurately modeling blowout control operations on a floating drilling vessel in deep water. |
| a. | Well scaling and design. |
| b. | Preparation of bids and specifications. |

| <u>Task</u> | <u>Description</u> |
|-------------|--|
| 3 | Documentation of blowout control equipment configuration and procedures used on all floating drilling vessels capable of drilling in deep water. |
| a. | Equipment configuration. |
| b. | Shut-in procedures. |
| c. | Start-up procedures. |
| d. | Pump-out procedures. |
| 4 | Experimental study of shut-in procedures for blowout control on floating drilling vessels in deep water. |
| a. | Experimental determination of frictional area coefficient profile of modern adjustable chokes and HCR valves used in Blowout Control operations. |
| b. | Experimental determination of frictional area coefficient profile of modern annular Blowout Preventers During Closure. |
| 5 | Experimental Study of Procedures for Handling Upward Gas Migration during the Shut-in Period. |
| a. | Evaluation of conventional approach requiring use of surface drill pipe pressure. |
| b. | Evaluation of volumetric methods. |
| c. | Laboratory investigation of gas bubble fragmentation while rising in a static annulus. |
| d. | Development of mathematical model of well behavior during shut-in period following a gas kick. |
| e. | Determination of optimal method of handling upward gas migration during shut-in period. |

ACCOMPLISHMENTS

Task 1, well scaling and design, has been completed. A scale model of the proposed new facility has been constructed. The scale model will facilitate obtaining industry support for much of the needed equipment as well as provide a model for the construction phase of the project.

Work on Task 3, the documentation of blowout control equipment configurations and procedures, is still in the planning phase. Bob Surcouf has been assigned this task as part of his M.S. thesis research. All vessels currently capable of drilling in water depths of 2000 ft or more have been identified and a time schedule has been set-up for visiting the rig owners and requesting the needed information.

The experimental work on Task 4, an experimental study of shut-in procedures, is still continuing. Mud density effects are now being investigated. The test stand constructed for Task 4a by NL-Shaffer has been received. Our research associates are now installing and testing this equipment (See attached photographs). Collection of data using this equipment should begin within the next few weeks. Completion of Task 4 is now estimated to be March 30, 1980.

The experimental work on Task 5, an experimental study of procedures for handling upward gas migration during the shut-in period, is proceeding rapidly. Jeff Mathews has been assigned Tasks 5a, b and d as part of his M.S. thesis research. A total of 7 experimental runs have been made to date in the 6000 ft well. A mathematical model is simultaneously being developed. Vicente Casariego has been assigned Task 5c as part of his M.S. thesis research. The three story laboratory model is under construction.

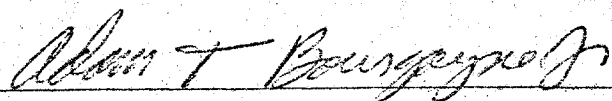
It is expected that the construction will be complete in March, 1980 and that some data will be available early in April. Scott Doyle has been assigned Task 5e as part of his M.S. thesis research. Scott is currently exploring methods of including the effects of formation fracture on wellbore pressure behavior. If this can be done, much more general procedures for handling upward gas migration could be developed.

PROBLEMS

No major technical problems have been encountered since our last progress report. A review of our budget shows that the tasks funded to date can be accomplished within the original budget, although some transfer of funds between categories may be necessary.

CHANGES

No significant changes have been made since our last progress report.



Adam T. Bourgoyne, Jr., Chairman
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